Exhibit R-2, PB 2010 Defense Advanced Research Projects Agency **RDT&E Budget Item Justification**	**DATE:** May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603287E SPACE PROGRAMS AND TECHNOLOGY

COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	146.494	226.394	200.612						Continuing	Continuing
SPC-01: SPACE PROGRAMS AND TECHNOLOGY	146.494	226.394	200.612						Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Space Programs and Technology program element is budgeted in the Advanced Technology Development budget activity because it addresses high payoff opportunities to dramatically reduce costs associated with advanced space systems and provides revolutionary new system capabilities for satisfying current and projected military missions.

(U) A space force structure that is robust against attack represents a stabilizing deterrent against adversary attacks on space assets. The keys to a secure space environment are situational awareness to detect and characterize potential attacks, a proliferation of assets to provide robustness against attack, ready access to space, the ability to neutralize man-made space environments, and a flexible infrastructure for maintaining the capabilities of on-orbit assets. Ready access to space allows the delivery of defensive systems and replenishment supplies to orbit. An infrastructure to service the mission spacecraft allows defensive actions to be taken without limiting mission lifetime. In addition, developing space access and spacecraft servicing technologies will lead to reduced ownership costs of space systems and new opportunities for introducing technologies for the exploitation of space.

(U) Systems development is also required to increase the interactivity of space systems, space-derived information and services with terrestrial users. Studies under this project include technologies and systems that will enable satellites and microsatellites to operate more effectively by increasing maneuverability, survivability, and situational awareness; enabling concepts include solar thermal propulsion, novel ion-thruster applications, payload isolation and pointing systems.

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B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	216.419	287.009	211.510	
Current BES/President's Budget	146.494	226.394	200.612	
Total Adjustments	-69.925	-60.615	-10.898	
Congressional Program Reductions	0.000	-60.615		
Congressional Rescissions	-64.000	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	-5.925	0.000		
TotalOtherAdjustments			-10.898	

Change Summary Explanation

FY 2008
Decrease reflects Section 8042 rescission and the SBIR/STTR transfer.

FY 2009
Decrease reflects the reductions for Section 8101 Economic Assumptions and the Blackswift testbed.

FY 2010
Decrease reflects minor program repricing.

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APPROPRIATION/BUDGET ACTIVITY	**R-1 ITEM NOMENCLATURE**	**PROJECT NUMBER**
0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	PE 0603287E SPACE PROGRAMS AND TECHNOLOGY	SPC-01

COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
SPC-01: SPACE PROGRAMS AND TECHNOLOGY	146.494	226.394	200.612						Continuing	Continuing

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Space Surveillance Telescope (SST)	12.833	3.134	2.000	
(U) The Space Surveillance Telescope (SST) program will develop and demonstrate an advanced ground-based optical system to enable detection and tracking of faint objects in space, while providing rapid, wide-area search capability. A major goal of the SST program is to develop the technology for large curved focal surface array sensors to enable an innovative telescope design that combines high detection sensitivity, short focal length, wide field of view, and rapid step-and-settle to provide orders of magnitude improvements in space surveillance. This capability will enable ground-based detection of un-cued objects				

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
in deep space for purposes such as asteroid detection and space defense missions. The Air Force will participate in the DARPA funded developmental testing of SST and then take over operation of SST as a sensor in the Air Force Space Surveillance Network. A Memorandum of Agreement (MOA) has been established with Air Force Space Command for transition. *FY 2008 Accomplishments:* - Developed and fabricated a mosaic of Charge-coupled devices (CCDs) to form a curved focal surface array. - Designed and fabricated a telescope enclosure and supporting infrastructure at White Sands Missile Range. - Integrated telescope elements at contractor facility. *FY 2009 Plans:* - Construct sensor subsystem. - Develop, test, and validate software for autonomous telescope operations and data reporting. - Complete processing of primary and secondary telescope mirrors. - Complete construction of telescope enclosure. - Integrate telescope elements on site. *FY 2010 Plans:* - Validate end-to-end telescope performance and surveillance operations.				
Novel Satellite Communications (NSC) (U) The aim of the Novel Satellite Communications (NSC) program was the development of a multi-user satellite communications (SATCOM) system that allows ground-based users with handheld radios to communicate with the satellite at high data rates, even when the users are close to multiple jammers and/or located in urban (i.e. severe multi-path) settings. This was accomplished through novel signal processing, communications and coding techniques. The NSC technology will transition to the Navy (SPAWAR) and Air Force Space and Missile Systems Center beginning in 2009.	0.622	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2008 Accomplishments: - Conducted additional experimental data collection and processing. - Finalized design of a post-transition NSC demonstration system. - Assessed performance potential with NSC applied to Navy MUOS (Multi-User Objective System) satellite ground stations. - Supported evaluation and transition of NSC technology.				
Integrated Sensor is Structure (ISIS) (U) The Integrated Sensor is Structure (ISIS) program is developing a sensor of unprecedented proportions that is fully integrated into a stratospheric airship that will address the nation's need for persistent wide-area surveillance, tracking, and engagement for hundreds of time-critical air and ground targets in urban and rural environments. ISIS is achieving radical sensor improvements by melding the next-generation technologies for enormous lightweight antenna apertures and high-energy density components into a highly-integrated lightweight multi-purpose airship structure - completely erasing the distinction between payload and platform. The ISIS concept includes ninety-nine percent on-station 24/7/365 availability for Simultaneous Airborne Moving Target Indicator (AMTI) (600 kilometers) and Ground-Based Moving Target Indicator (GMTI) (300 kilometers) operation; ten years of autonomous, unmanned flight; hundreds of wideband in-theater covert communications links; responsive reconstitution of failed space assets; plus CONUS-based sensor analysis and operation. Beginning in FY 2010, this program will be budgeted in PE 0603286E, Project AIR-01. The ISIS technology is planned for transition to the Air Force. *FY 2008 Accomplishments:* - Demonstrated lightweight technologies for system integration (i.e. high-energy density batteries, electronic circuits on thin-film barrier materials, advanced multi-purpose airship hulls, and regenerative fuel technologies). - Developed a conceptual design and fully-operational scaled flight system demonstrating complete system integration over an extended period.	29.034	78.400	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Conduct preliminary design review of demonstration system. - Develop and demonstrate calibration and compensation subsystem. - Demonstrate large-scale critical integrated subsystems. - Design radar resource controller for dynamically assigned aperture.				
Deep View (U) The Deep View program goal was to develop a high-resolution radar imaging capability to characterize objects in earth orbit, with special emphasis placed on imaging small objects at orbits ranging from low earth orbit to geosynchronous orbit. The approach was based upon a large aperture imaging radar system redesigned to operate at very high power over very broad bandwidth at W-band. Key technology development focused on: 1) transmitters capable of providing the required power to image at deep-space ranges over full bandwidth, and 2) an antenna design that maintains the necessary form factor over a very large aperture. The program concluded following completion of a power combining test of three gyro-twystron tubes in a single sub-band. The Deep View technologies have transitioned to the Air Force. *FY 2008 Accomplishments:* - Demonstrated gyro-twystron power combining to establish diplexer performance. - Provided developed technologies to the Air Force for transition into its radar program of record.	0.730	0.000	0.000	
Long View (U) The Long View program developed an inverse synthetic aperture laser radar (LADAR) that enabled the high-resolution imaging of geostationary satellites when coupled to a large aperture telescope. Specifically, the technologies developed in the Long View program were an optical reference oscillator that is stable over the propagation time to a geostationary satellite (GEOSTAT) and back (about a quarter of a second) and autofocus algorithms that restore image quality that has been degraded due to atmospheric turbulence and optical reference oscillator instability over the imaging time (about 100 seconds). These two technologies are required in order to make inverse synthetic aperture LADAR systems feasible for objects in geostationary orbits.	3.809	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2008 Accomplishments: - Demonstrated that the stable optical reference oscillator meets stability requirements. - Demonstrated that the autofocus algorithm is capable of eliminating the blurring due to atmospheric turbulence and stable optical reference oscillator instability over the imaging time. - Investigated applicability of Long View technologies for other orbits. - Made technologies available to the Navy for transition.				
Falcon (U) The Falcon program objectives are to develop and demonstrate hypersonic technologies that will enable prompt global reach missions. The technologies include high lift-to-drag techniques, high temperature materials, precision navigation, guidance, and control, communications through plasma, and an autonomous flight safety system. Leveraging technology developed under the Hypersonic Flight (HyFly) program, Falcon will address the implications of hypersonic flight and reusability using a series of hypersonic technology vehicles (HTVs) to incrementally demonstrate these required technologies in flight. The HTV-2 program will demonstrate enabling hypersonic technologies for future operational systems through rocket-boosted hypersonic flights with sufficient cross-range and downrange performance to evaluate thermal protection systems, aerodynamic shapes, maneuverability, and long-range communication for hypersonic cruise and re-entry vehicle applications. Technologies developed under Falcon would also allow for a low cost, responsive Small Launch Vehicle (SLV) capable of launching small satellites into low earth and sun synchronous orbits and will provide the nation a new, small payload access to space capability. The Falcon program addresses many high priority mission areas and applications such as global presence and space lift. DARPA established a Memorandum of Agreement (MOA) with the Air Force for the HTV-2 program in May 2003 and with NASA in October 2004. The effort has been jointly funded with the Office of Secretary of Defense Global Strike program office in FY 2008 and FY 2009. Falcon capabilities are planned for transition to the Air Force in FY 2010. *FY 2008 Accomplishments:* - Constructed a second horizontal test stand (HTS) for Phase 2C testing with more instrumentation. - Refurbished the vertical test stand (VTS) with new propellant tanks and instrumentation. - Redesigned the injector to address the instability and thermal issues from Phase 2B.	25.000	25.000	14.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Conducted hot fire system-checks using the new Phase 2C engine on the HTS. - Conducted critical design review of HTV-2 demonstration system. - Initiated assembly, integration, and testing (AI&T) of two HTV-2 vehicles. - Continued assembly and modification of two Minotaur IV Lite launch vehicles. - Completed twenty-seven, twenty second hot fire tests on the new HTS. - Completed three long-duration hot fire tests on the new VTS. - Fully characterized the VaPak engine and assessed its performance. *FY 2009 Plans:* - Complete AI&T of two HTV-2 vehicles. - Conduct flight test of first HTV-2 vehicle incorporating next generation hypersonic technologies. *FY 2010 Plans:* - Conduct flight test of second HTV-2 vehicle demonstrating increased thermal environment and cross-range capability.				
Mode Transition (MoTr) Demonstration (U) The Mode Transition (MoTr) Demonstration program, an outgrowth of the Falcon program, seeks to ground test a turbine-based combined-cycle (TBCC) engine using hydrocarbon fuel. The MoTr program will demonstrate transition from turbojet to ramjet/scramjet cycle and is the critical experiment required to enable reusable, air-breathing, hypersonic flight. MoTr leverages previous and on-going advances in air-breathing propulsion technology, including Falcon combined-cycle engine technology and the Air Force/ DARPA High Speed Turbine Engine Technology Demonstration (HiSTED) program. Beginning in FY 2010, this program will be funded in PE 0603286, Project AIR-01, Advanced Aerospace Systems. *FY 2009 Plans:* - Complete Falcon freejet testing. - Select a turbojet from the HiSTED program. - Complete preliminary design of a TBCC engine model. - Complete facility assessment study to select a primary facility.	0.000	10.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete preliminary design of primary facility modifications.				
Satellite Program for Instant Depletion of Energetic Radiation (SPIDER)*	12.710	17.000	31.800	

*Formerly Sleight of HAND (SOH).

(U) The effects of High Altitude Nuclear Detonations (HAND) are catastrophic to satellites. HAND-generated charged particles are trapped for very long periods of time, possibly for years, oscillating between the earth's north and south magnetic poles. This enhanced radiation environment would immediately degrade low earth orbiting (LEO) spacecraft capability and result in their destruction within a few weeks. The Satellite Program for Instant Depletion of Energetic Radiation (SPIDER) is a proof-of-concept demonstration of the technology and techniques to rapidly mitigate the HAND-enhanced trapped radiation within days of a HAND event, before LEO spacecraft capabilities are degraded. Other proposed remediation methods are slower, taking weeks or months versus days, and would result in spacecraft degradation and would require asset replacement. The SPIDER program will use a satellite-based neutral gas release to generate plasma waves over a large region of the trapped radiation belts. Trapped electrons will experience plasma wave induced accelerations and pitch angle scattering. Pitch angle scattering causes the harmful electrons to be precipitated out of the radiation belt and neutralized in the earth's atmosphere. Complementary efforts will include the development of an end-to-end model and the development of techniques to measure and probe the state of the ionosphere, particularly the population density of trapped high energy electrons. Following modeling and analysis, laboratory proof-of-concept experiments and a risk reduction sounding rocket flight, a space-based demonstration will be pursued as a pathfinder for a future program to develop an operational radiation belt remediation capability. Potential transition partners include the Navy and Air Force.

FY 2008 Accomplishments:
- Performed detailed modeling and analysis of neutral gas release approach to determine the potential efficiency of the high energy electron remediation process.
- Used results of ground-based SPIDER experiments to enhance requirements for a space-based SPIDER demonstrator.

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Develop conceptual design for the on-orbit space demonstration. - Prepare for risk reduction sounding rocket flight. *FY 2010 Plans:* - Perform risk reduction sounding rocket flight, evaluate results, and incorporate into proposed demonstration. - Develop system requirements and conduct system requirements review and develop preliminary design.				
RAD Hard by Design (U) This program is developing, characterizing, and demonstrating microelectronic design technologies to enable fabrication of radiation hardened electronic components using leading-edge, commercial fabrication facilities. The current mainstream approach for fabricating radiation-hardened electronics depends on specialized process technologies and dedicated foundries that serve this military market niche. While commercial semiconductor fabrication is not explicitly radiation hardened, recent trends in deeply scaled fabrication such as very thin oxides, trench isolation, and multiple levels of metal are resulting in semiconductor devices that are inherently more tolerant of radiation than older generations. This program is pursuing development of design-based technologies that will enable pure commercial fabrication technologies to attain radiation hardened electronics equivalent to those from the dedicated foundries. The design technology developed under the Radiation Hardening by Design (RHBD) program is planned for transition to the Air Force and to the Defense Threat Reduction Agency (DTRA) at the end of Phase II, which is anticipated to be completed by FY 2009. Specific design libraries for hardened circuits will transition through the defense electronics design industry, which are being supported largely by DTRA and the Air Force. *FY 2008 Accomplishments:* - Identified candidate system-on-a-chip integrated circuit (IC) to harden utilizing the RHBD standard cell libraries previously developed by this program.	4.720	3.705	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Fabricated "intermediate" demonstration IC as preliminary to the complete RHBD version of the system on chip (SOC) above. - Began exploration of 65 nanometer (nm) technology with respect to RHBD methods. - Began exploration of silicon on insulator (SOI) technology with respect to RHBD methods. *FY 2009 Plans:* - Fabricate and test "final" RHBD demo ICs chosen in FY 2008 (90 nm complementary metal oxide semiconductor (CMOS) technology). - Complete investigation of RHBD efficacy in 65 nm CMOS technology. - Complete investigation of RHBD efficacy in SOI technology.				
Microsatellite Demonstration Science and Technology Experiment Program (MiDSTEP) (U) The Microsatellite Demonstration Science and Technology Experiment Program (MiDSTEP) will develop advanced technologies, capabilities, and space environment characterization required to demonstrate a suite of advanced lightweight microsatellite technologies integrated into high performance microsatellites across the continuum from low earth orbit (LEO) to deep space super geosynchronous orbit (GEO) environments. The program will integrate a variety of advanced technologies, which have not been previously flight-tested, and may include: lightweight optical space surveillance/situational awareness sensors, lightweight power, chemical and electric propulsion systems, advanced lightweight structures, advanced miniature RF technology including micro crosslink and use of COTS approaches, active RF sensor technology, COTS processor and software environment, miniature navigation technologies, including the use of starfields for deep space navigation, and autonomous operations. The developed capabilities will include high thrust, high efficiency solar thermal propulsion systems that can enable responsive orbit transfer as well as provide radiation resistant high-density electrical power. The program will also explore ultra-stable payload isolation and pointing systems and components to enable advanced miniature communication systems. In addition, the program will also consider affordable, responsive fabrication and integration approaches and the possibility of networking microsatellites/modules to create a flexible architecture of assets responsive to multiple missions and threats. The anticipated transition partner is the Air Force.	8.875	5.750	3.312	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Completed initial examination of micro-propulsion technologies. - Studied the use of large composite structures for pico and nanosatellite use. *FY 2009 Plans:* - Conduct system design trades of appropriate technologies. - Perform mission utility assessments and feasibility studies and develop concepts of operation. *FY 2010 Plans:* - Design and develop microsatellite system concepts and integrate selected technologies. - Perform component and subsystem ground tests.				
System F6 (U) The goal of the System F6 program is to demonstrate a radically new space system composed of a heterogeneous network of free flying or loosely connected small satellite modules that will, working together, provide at least the same effective mission capability of a large monolithic satellite. Current large space systems used for national security purposes are constrained due to their monolithic architecture. They can be launched only on a small number of large launch vehicles, cannot readily be upgraded and/or reconfigured with new hardware on-orbit, and are risk-intensive, since the unforgiving launch and space environments can result in a total loss of investment with one mistake. The System F6 will partition the tasks performed by monolithic spacecraft (high bandwidth communications downlink, information processing, data storage, navigation, power, etc.) and assign each task to a dedicated small or micro satellite. This new fractionated space system architecture offers the potential for reduced risk, greater flexibility (e.g., on-orbit maintainability, scalability, adaptability, evolvability), enhanced robustness (e.g. survivability to attack, decreased mission impact due to launch vehicle failures), payload isolation, and faster deployment of initial capability. This program will develop, design, and test new space system architectures and technologies required to successfully decompose a conventional spacecraft into fundamental elements. Such architectures include, but are not limited to: robust, self-forming, and reliable networks; ultra-secure wireless data communications; dynamically reconfigurable service oriented distributed computing systems; wireless power systems; autonomous cluster navigation systems;	21.095	44.675	92.700	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
distributed payload approaches; and reliable, robust, rapidly re-locatable ground systems. The anticipated transition partner is the Air Force. *FY 2008 Accomplishments:* - Developed a conceptual design and fractionated system concepts, and integrated selected technologies. - Formulated econometric value-modeling methodologies to inform system engineering trade decisions. - Conducted Hardware-In-the-Loop (HIL) demonstrations of successively greater capability simulating a wireless network operating environment for fractionated satellite systems. - Developed trajectories for launch, deployment, and sustainment of cluster satellite systems. - Reviewed feasibility of wireless power transfer approaches for inter and intra-satellite operations. *FY 2009 Plans:* - Develop a preliminary design of the on-orbit demonstration system. - Perform component and subsystem ground tests. - Conduct HIL demonstrations of successively greater capability simulating 1) wireless network operating environment for fractionated satellite systems, 2) orbit propagation with real world dynamics, 3) guidance, navigation and control schemes, 4) cluster flying algorithms, and 5) distributed resource management. - Refine system design to include a detailed description of spacecraft and ground modules, subsystem-level allocation of mass, power and reliability, trade space definition for each technology, and risk analysis with mitigation schemes. *FY 2010 Plans:* - Continue refinement of the design of the on-orbit demonstration system, leading to a critical design. - Continue to perform component and subsystem ground tests. - Continue conducting HIL demonstrations, with increased fidelity provided by integration of actual flight and/or prototype hardware into the testbed. - Build and/or modify mechanical and electrical test support systems in preparation for assembly and test of flight demonstration system spacecrafts. - Initiate construction of flight demonstration system spacecraft.				

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Front-end Robotics Enabling Near-term Demonstration (FREND)	9.100	11.950	7.000	

(U) The goal of the Front-end Robotics Enabling Near-term Demonstration (FREND) program is to develop, demonstrate and fly robotic manipulator technologies designed to allow interaction with geosynchronous orbit (GEO)-based military and commercial spacecraft, extending their service lives and permitting satellite repositioning or retirement. Existing GEO spacecraft are outfitted with sufficient propellant to provide for needed station keeping, repositioning, and retirement maneuvers, which in many cases defines their useful mission durations. Once this propellant is expended, the vehicle is retired and, in many cases replaced. FREND technologies can enable significant service extension to these spacecraft through re-boosting near end-of-life. Recent events have significantly increased the number of objects in low earth orbit (LEO), particularly in orbital planes of most interest to DoD users, causing an increased threat to safe space operations. FREND combines detailed photogrammetric and laser imaging with robotic multi-degree-of-freedom manipulators to autonomously grapple space objects not outfitted with custom interfaces. A FREND-based servicing spacecraft offers the potential for spacecraft salvage, repair, rescue, reposition, de-orbit and retirement, and debris removal. The program will examine possible solutions for all classes of LEO debris to determine the most economical technical solution set to mitigating the problem. In addition, FREND will investigate neurorobotics as a potential replacement for the baseline suite of algorithms (e.g., arm trajectory planning, vehicle pose estimation, grapple feature identification, or compliance control) required to dock multiple robotic arms with a client spacecraft. The anticipated transition partner is the Air Force.

FY 2008 Accomplishments:
- Procured and fabricated flight hardware for integration and testing.
- Conducted robotic payload ground test.
- Tested control schemes in 1G (earth's gravity) environment.
- Conducted hardware-in-the-loop testing of flight hardware in proximity operations test facility.
- Assessed applicability of neurorobotic technologies to the FREND robotic payload.

FY 2009 Plans:
- Work with mission partner to develop demonstration mission.

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Conduct Conceptual Design Review of FREND-based servicing spacecraft with potential mission partners. - Conduct analysis of LEO debris. *FY 2010 Plans:* - Demonstrate application of neurorobotic technology to FREND payload in "earth's gravity" environment. - Initiate a preliminary design of the FREND based servicing spacecraft. - Initiate studies of LEO debris solutions.				
Fast Access Spacecraft Testbed (FAST) (U) The goal of the Fast Access Spacecraft Testbed (FAST) program is to demonstrate a suite of critical technologies including high efficiency solar cells, sunlight concentrating arrays, large deployable structures and ultra light weight solar arrays. These technologies enable light weight, high efficiency and high-power satellites, 20kW scalable to 80kW or more. The specific power goal is 130 W/Kg yielding an ultra light-weight power system of approximately 150 Kg for a 20kW array. Combined with electric propulsion, FAST enables fast-transfer roaming satellites with nearly five times the fuel efficiency of conventional chemical propulsion. For example, FAST will permit on-demand access to any point on the geosynchronous ring or within the high-altitude, super synchronous "graveyard" (where derelict systems are regularly repositioned in order to free up orbital slots within the ring), greatly improving our ability to rapidly deploy and reposition satellites, as well as monitor the geosynchronous environment. Alternatively, FAST will permit responsive launch capabilities including deployment of small geosynchronous satellites on small launch vehicles. Scaled up systems will nearly double the effective satellite mass launched to high altitude orbits today, significantly downsizing the need for large launch vehicles. The anticipated transition partner is the Air Force. *FY 2008 Accomplishments:* - Conducted preliminary design and technology selection.	7.000	10.730	14.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Perform detailed design, development, and ground testing of the FAST spacecraft high-power generation subsystem. - Demonstrate mechanical deployment of full-scale solar concentrator and heat rejection system in 1G environment. - Initiate design and development of the FAST demonstrator spacecraft. *FY 2010 Plans:* - Integrate FAST high-power generation subsystem with demonstrator spacecraft.				
NanoPayload Delivery (NPD) (U) The NanoPayload Delivery (NPD) program studied the technical feasibility of ultra-lightweight, rapid-response spacecraft delivery from land, sea, or air-based platforms. Such nanopayloads (1-10 kilograms) could be boosted to low earth orbit (200 km altitude) in a matter of hours following call-up. The program examined the use of ongoing technology development efforts, which permit the fabrication of microscale pumps, thrust chambers, and valves. Such rocket engines, which are theoretically capable of thrust-to-weight ratios of 100:1 or greater, would allow for significant reductions in overall engine mass and permit nanosatellites to be placed in low orbits for several weeks to months. Delivery systems considered included: (1) a stock aircraft, such as the F-15E or F-16, (2) a truck-mounted erector, or (3) the deck of a small naval vessel. *FY 2008 Accomplishments:* - Surveyed existing aircraft-, land-, and sea-based missile platforms for compatibility with NPD mission constraints and requirements. - Designed, fabricated, and tested a micro chemical engine; including pumps, lines, valves, and thrust chamber to validate performance models.	2.966	0.000	0.000	
Space Situational Awareness (SSA) & Counterspace Operations Response Environment (SCORE) (U) The goal of the Space Situational Awareness (SSA) & Counterspace Operations Response Environment (SCORE) program is to develop and demonstrate an operational framework and responsive	4.000	4.800	10.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
defense application to enhance the availability of vulnerable commercial space-based communications resources. SCORE will correlate a wide range of operational support and space system ground user data to rapidly identify threat activities, propose mitigating countermeasures, and verify the effectiveness of selected responses. Critical technologies include accessing disparate sources of relevant data, model-based situational awareness, and candidate response generation and evaluation. Particular emphasis will be placed on the ability to continuously adapt to changes in defended system components and usage patterns as well as validation of SCORE system integrity. The potential transition customer is the Air Force. *FY 2008 Accomplishments:* - Developed initial system requirements and design. - Developed list of applicable systems and identified relevant sources of data. *FY 2009 Plans:* - Conduct system trades and validate critical components. - Mature system parameters and operational procedures. *FY 2010 Plans:* - Develop algorithms and software required to integrate disparate information into a single framework. - Integrate software environment into a suite of visualization products that provide situational awareness and decision making tools.				
MEO Synthetic Aperture Radar (MEOSAR) (U) Synthetic Aperture Radar (SAR) integration time is currently limited by the amount of ground vehicle motion encountered during the synthetic aperture collection time. For space radar systems, this has traditionally meant that SAR had to be accomplished at low earth orbit (LEO) trajectories where the collection time would be much shorter given the high speeds of a LEO satellite. Although the specifics depend heavily on geometric considerations, medium earth orbit (MEO) SAR imaging intervals can be a factor of approximately eight longer, compared to a LEO alternative. The longer integration times required at MEO can have a major impact on the quality of the otherwise equivalent SAR image due	0.000	1.750	4.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
to the presence of internal motion within the image scene. To achieve equivalent quality imagery, the contribution of the moving targets within the image must be excised. The MEO Synthetic Aperture Radar (MEOSAR) program will develop techniques to identify moving targets and extract them from the data prior to imaging to avoid the streaking caused by their motions. The program will develop reliable automated detection of moving targets within SAR imagery using a double thresholding process in interferometric phase and amplitude. This moving target detection technique can be readily reversed to excise the moving targets from the clutter (image) background. Temporal sub-array processing will demonstrate early detection and rejection of moving targets in sub-array images. The program will develop improved motion detection and removal algorithms, demonstrate their performance on simulated and airborne data, and develop an architectural concept for a MEOSAR system. The developed technology will be transitioned to the Air Force. *FY 2009 Plans:* - Perform compact test range demonstration validating system concept and algorithms. - Complete design for a potential flight demonstration system. *FY 2010 Plans:* - Initiate final design plans for the flight demonstration system. - Complete subsystem technologies.				
Bi-Static Shield (U) The Bi-Static Shield program will utilize existing satellite tracking, telemetry and control (TT&C) antennas from NASA's Goldstone tracking site to illuminate geosynchronous (GEO) satellites. Using ground-based radio astronomy antennas located across the country to serve as bi-static receivers, reflections from small GEO intruder satellites will be processed to form 3-D images, useful for determining their function and threat potential. Use of existing satellite transmit antennas to generate a bi-static electromagnetic shield would demonstrate the utility of very important situational awareness capability without the need for additional on-orbit assets around individual satellites. The Bi-Static Shield program is planned for transition to the Air Force for space situational awareness applications.	0.000	3.500	2.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Conduct modeling and simulation to determine algorithms required. - Assess availability of ground and space-based objects for concept demonstration. - Conduct proof-of-principle demonstrations of basic concept. *FY 2010 Plans:* - Conduct additional measurement campaigns on additional space-based objects. - Refine algorithms as required.				
High Delta-V Experiment (HiDVE) (U) The goal of the High Delta-V Experiment (HiDVE) program is to design, develop, and demonstrate a low-mass, low-volume, high delta-V solar thermal propulsion (STP) engine suitable for integration with approximately a 15kg nanosatellite host. The enabling technologies are very high-temperature materials and light-weight solar concentration systems. A HiDVE system will provide small satellites, historically constructed without propulsive capability, with substantial delta-V affording nanosatellites increased orbital range, in terms of both altitude and plane. In addition, this flexibility will be essential to future nanosatellite mission designers and operators, who will be able to take advantage of less-than-optimal insertion orbits and later move to an intended mission orbit. Specific objectives of the HiDVE program include: development and demonstration of a functioning STP system in a relevant environment; an operational test plan that outlines the steps needed to flight-qualify an integrated nanosatellite with an STP system. The Air Force is the expected transition partner. *FY 2008 Accomplishments:* - Developed a functioning high delta-V solar thermal propulsion system design for relevant environments. *FY 2009 Plans:* - Develop and ground demonstrate low-cost, low-volume solar thermal propulsion prototypes. *FY 2010 Plans:* - Integrate HiDVE prototype with nanosatellite host.	4.000	6.000	13.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
High Orbit Manufacture & Assembly of Space Structures (HiMASS)	0.000	0.000	6.800	

(U) The goal of the High Orbit Manufacture & Assembly of Space Structures (HiMASS) program is to mature and demonstrate the technology for lightweight, volumetrically efficient and affordable large space structures. Such structures autonomously deployed, assembled or manufactured on orbit can support a wide range of future military applications ranging from revolutionary intelligence, surveillance and reconnaissance (ISR) and communications to high power energy generation. For example, large apertures and supporting structures will enable migration of ISR assets from low earth orbit (LEO) to medium earth orbit (MEO)/geosynchronous orbit (GEO) enhancing survivability and dramatically improving persistence over theater, in some cases enabling continuous coverage. Similarly, GEO communications satellites with very large antennas and supporting structures can dramatically improve the quality and bandwidth of communications while radically reducing the size and weight of ground based antennas and communications equipment carried by the warfighter.

FY 2010 Plans:
- Develop HiMASS preliminary design, risk management plan, and technology and system maturation plan.

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Falcon/OSD	23.900	11.000	0.000						Continuing	Continuing
Space Surveillance Telescope/USAF	0.000	1.100	0.000						Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.